

REMARKS

By this Response, claims 1 and 16 have been amended. No claims have been added or canceled. Claims 1-6, 8-16, and 18-22 remain pending. Support for the amendments to the claims can be found throughout the as-filed specification and claims, in particular at paragraph [0020]. No new matter has been added.

Rejection of Claims 1, 2, 4-6, 9-10, 16, and 19-20 Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected claims 1, 2, 4, 5, 6, 9, 10, 16, 19 and 20 under 35 U.S.C. § 103(a) as being unpatentable over *Lee et al.* (U.S. Publication No. 2002/0121692) in view of *Kondo et al.* (U.S. Patent No. 5,656,858) or in the alternative, as being unpatentable over *Lee et al.* in view of *Bojkov et al.* (U.S. Publication No. 2005/0073048) and further in view of *Kondo et al.* These rejections are respectfully traversed.

The subject matter of independent claims 1 and 16 are directed to methods comprising, *inter alia*, subjecting the seed layer to a wet etch, wherein the wet etch is without substantially undercutting the etched seed layer or surface conductive lead and without substantially affecting the barrier layer; and subjecting the portion of the barrier layer to a dry etch, subsequent to subjecting the seed layer to the wet etch, to remove the portion thereby forming a skirt, the dry etch selective to the barrier layer without substantially undercutting the etched seed layer or surface conductive lead, without a width reduction of the surface conductive lead, and without oxide formation on side walls of the surface conductive lead.

It is the Examiner's position that *Lee et al.* disclose a method for manufacturing an integrated circuit as claimed, with the exception of explicitly teaching the anisotropic etch to comprise a dry etch. Accordingly, *Kondo et al.* are applied for subjecting a portion of a barrier layer to a dry etch, referring to Fig. 7E; col. 10, lines 33-39; col. 7, lines 65-67, diameter of barrier layer is larger than surface lead, the dry etch selective to the barrier layer (layer 105 etched while underlying layers 104, 101, etc are not). Alternatively, the Examiner provides *Bojkov et al.* to support the position that it would have been obvious to remove the seed layer by wet etch.

To the contrary, *Lee et al.* simply disclose width reduction of the pillar 38, noting that the reduction can be either by wet chemical etching or an isotropic dry etch, selective to the pillar metal material. Specifics of etching the barrier layer 36 are not disclosed other than being anisotropic for Fig. 14.

Further, it is respectfully submitted that *Kondo et al.* fail to provide the missing teachings of *Lee et al.* in the manner suggested by the Examiner. Specifically, *Kondo et al.* provide two options for etching the components. In a first option, as found in column 9, lines 23-28, the Cu film 107 is etched with an etching liquid, then both the bonding layer 106 and barrier layer 105 are etched together with an etching liquid. Hence, two wet etching steps are used. The Examiner refers to column 10, lines 33-29 of *Kondo et al.* as providing support for a subsequent dry etch of the barrier layer, however, such an extraction ignores the remainder of this portion of *Kondo et al.* Instead, *Kondo et al.* require applying dry etching to all of the barrier metal 105, bonding layer 106, base film 107 and bump part 108 in order to control the etching rate of the bonding layer 106. Thus, the dry etch *Kondo et al.* is not selective and fails to recognize the significance of

or teach wet and then dry etch to selective layers of the structure as claimed. Because *Lee et al.* also fail to recognize the sequential wet and dry etching; there is no motivation to combine the references to obtain the claimed invention.

Likewise, the addition of *Bojkov et al.* as disclosing that wet etch of a seed layer fails to overcome the missing combination of *Lee et al.* in view of *Kondo et al.*

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejections of claims 1, 2, 4-6, 9, 10, 16, 19 and 20 under 35 U.S.C. § 103(a). Applicants respectfully submit that claims 2, 4-6, 9, 10 and claims 19, 20 are in condition for allowance, at least by virtue of their dependency from allowable claims 1 and 16, respectively.

Rejection of Claims 8 and 18 Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected claims 8-18 under 35 U.S.C. § 103(a) as being unpatentable over *Lee et al.* (U.S. Patent Publication No. 2002/0121692) in view of *Kondo et al.* (U.S. Patent No. 5,656,858), and further in view of *Bojkov et al.* (U.S. Patent Publication No. 2005/0073048). This rejection is respectfully traversed.

Claims 8 and 18 are directed to the wet etch chemistry comprising hydrogen peroxide and sulfuric acid.

It is the Examiner's position that *Bojkov et al.* overcome the deficiency of *Lee et al.* by etching a copper seed layer with a wet etch chemistry of hydrogen peroxide and sulfuric acid, referring to paragraph [0034] thereof.

To the contrary, it is respectfully submitted that the reference combination of *Lee et al.* in view of *Kondo et al.* fails at the outset for reasons presented above. The

addition of *Bojkov et al.* does not overcome these deficiencies, and the combination therefore also fails to teach or suggest the claimed invention.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 8 and 18 under 35 U.S.C. § 103(a). Applicants respectfully submit that claims 8 and 18 are in condition for allowance, at least by virtue of their dependency from allowable claims 1 and 16, respectively.

Rejection of Claim 3 Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected claim 3 under 35 U.S.C. § 103(a) as being unpatentable over *Lee et al.* (U.S. Patent Publication No. 2002/0121692) in view of *Kondo et al.* (U.S. Patent No. 5,656,858), and further in view of *Ashby et al.* (U.S. Patent No. 5,814,238); or, in the alternative, as being unpatentable over *Lee et al.* in view of *Bojkov et al.* (U.S. Patent Publication No. 2005/0073048). These rejections are respectfully traversed.

Claim 3 depends from claim 2 and further comprises nitrous oxide in the dry etch.

It is the Examiner's position that *Ashby et al.* overcome the deficiency of *Kondo et al.* by teaching the etching of tungsten titanium alloys using a dry etch of carbon tetrafluoride and nitrous oxide.

It is respectfully submitted that the primary reference combination of *Lee et al.* in view of *Kondo et al.* fails at the outset for reasons presented above. The addition of *Ashby et al.* does not overcome these deficiencies, and the combination therefore also fails to teach or suggest the claimed invention.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claim 3 under 35 U.S.C. § 103(a). Applicants further submit that claim 3 is in condition for allowance, at least by virtue of its dependency from allowable claim 1.

Rejection of Claims 21 and 22 Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected claims 21 and 22 under 35 U.S.C. 103(a) as being unpatentable over *Lee et al.* (U.S. Patent Publication No. 2002/0121692) in view of *Kondo et al.* (U.S. Patent No. 5,656,858) and further in view of *Nye, III et al.* (U.S. Patent No. 5,503,286), or in the alternative, as being unpatentable over *Lee et al.* in view of *Bojkov et al.* (U.S. Patent Publication No. 2005/0073048), further in view of *Kondo et al.* and further in view of *Nye, III et al.* These rejections are respectfully traversed.

Claims 21 and 22 are directed to a feature where a thickness of the skirt tapers down as it moves away from the surface conductive lead.

The Examiner recognizes that *Lee et al.* in view of *Kondo et al.* or *Lee et al.* in view of *Bojkov et al.* further in view of *Kondo et al.* do not explicitly disclose the resulting skirt to taper down as it moves away from the surface conductive lead. Accordingly, the Examiner has applied *Nye, III et al.*, referring specifically to FIG. 4A having layer 240 tapering out away from 300.

It is respectfully submitted that the reference combinations fail at the outset for reasons presented above. The addition of *Nye, III et al.* does not overcome these

deficiencies, and the combination therefore also fails to teach or suggest the claimed invention.

Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claims 21 and 22 under 35 U.S.C. § 103(a). Applicants respectfully submit that claims 21 and 22 are in condition for allowance, at least by virtue of their dependency from allowable claims 1 and 16, respectively.

CONCLUSION

In view of the foregoing remarks, Applicants submit that this claimed invention is neither anticipated nor rendered obvious in view of the prior art references applied against this application. Applicants therefore request the Examiner's reconsideration and reexamination of the application, and the timely allowance of the pending claims.

If the Examiner believes that additional discussions or information might advance the prosecution of the instant application, the Examiner is invited to contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.

Please grant any extensions of time required to enter this response and charge any additional required fees to Texas Instruments' deposit account 20-0668.

Respectfully submitted,

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